



Introducing Critical Thinking to Chemistry Capstone CH4500: The Plan, The Outcome, and What Next Goals

TANIA HOUJEIRY, PH.D.

SENIOR LECTURER

DEPARTMENT OF CHEMISTRY, COLLEGE OF SCIENCE

Course Objectives

The main objective for this course is to introduce students to the tools that help them :

- (1) synthesize knowledge of all of their experiences in the chemistry curriculum;
- (2) develop critical thinking to improve their creativity and problem solving skills; and
- (3) develop literacy in some of the major scientific and technological challenges of the 21st century.

“ Throughout this course I learned about the different research topics in Chemistry Department. I also learned to critically think. I think this was a great time in my college life to learn this” ~ Elyse

Course Activities

Reading
Papers

Group
presentations

HW

CV

Group
Discussions

Visiting
lecturers

Course Assessments

personal
journals

Peer
Evaluations

Group
journals

Tests

Sample Activity #1: Group Discussions

Activity included reading papers, then class discussion with a faculty member (this year it was Dr. Dieter)

Questions to discuss:

- *What is science? How does it differ from other forms of human endeavor?*
- *As an author, what do you think the major purpose(s) would be for writing and publishing a scientific paper? As an author, what do you think should be the major focus of your writing?*
- *Where do you think the major source of unethical behavior comes from in the modern world? Are there any cultural factors or institutions that make major contributions to unethical behavior?*

Sample Activity #1: Journal Entry

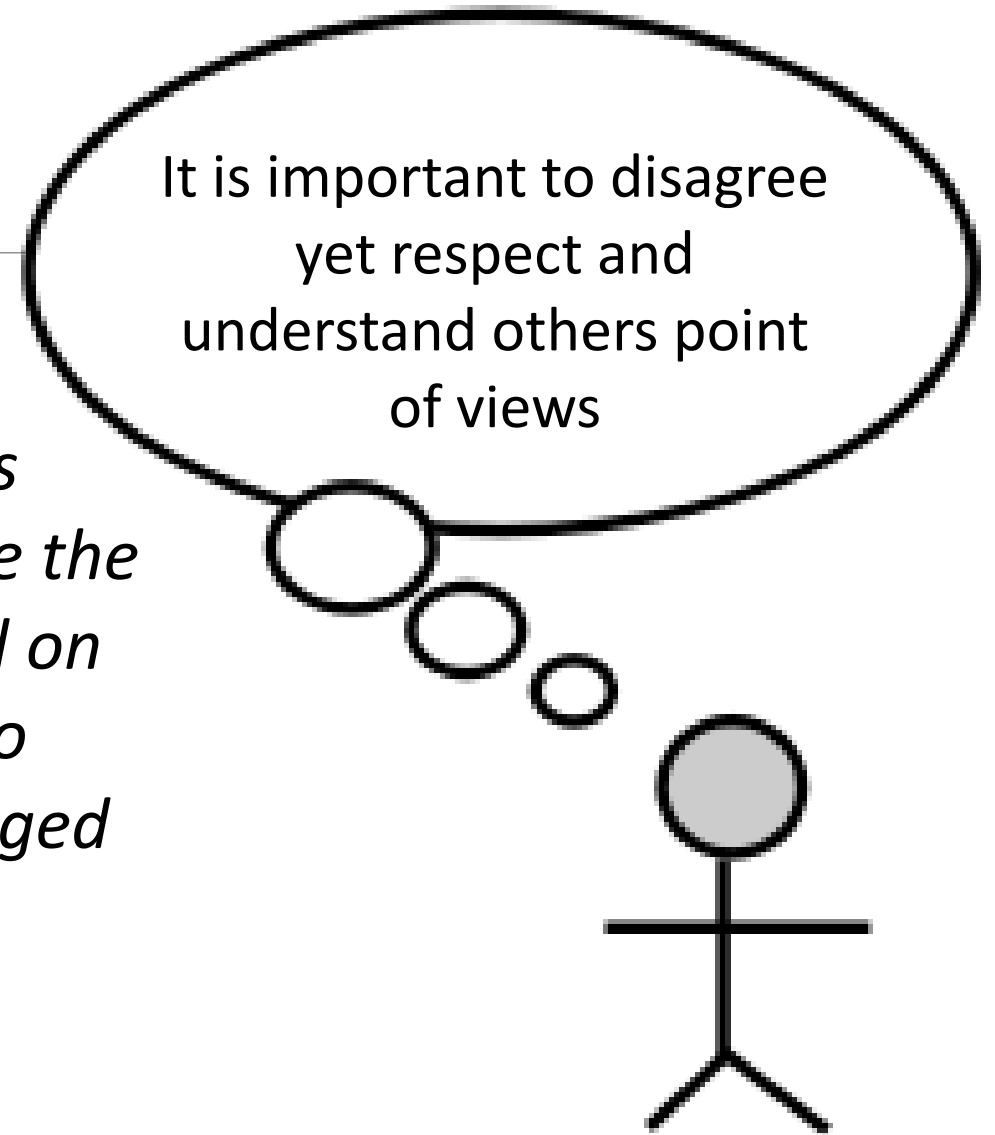
Students reflected on what they have learned from class discussions. They wrote that in their personal journals

Here is sample of Kinsey's Journal entry (last paragraph):

"One more thing that I feel is worth mentioning is Dr. Dieter said "science can't give you a meaning or purpose." I don't believe in this statement AT ALL because everyone's purpose in life is probably a little bit different. Nobody can say that everyone in the world has a certain purpose or doesn't have a certain purpose. We're all very different people with different personalities and I can't tell James what his purpose is or isn't in life. Only James can tell me what the answer is. I think that someone who is very passionate about science may have the mindset that their purpose to live is to conduct science."

Conclusions...

It was clear from journal entries that students were challenged intellectually to think outside the box. They agreed on certain points, disagreed on others but overall they were very respectful to each other, and couple of students even changed their point of view about certain topics...



Sample Activity #2: Group Presentations

For this activity, students were divided into three groups pro-vaccination and three groups anti-vaccination. Each group has to present a compelling argument to why it is important to vaccinate or why vaccines are bad...

The Assignment:

Introduction

Clear expectations of the presentations

Objective

Grading rubric

Critical Thinking Assignment (April 11 2018)

Anti-vaccination movement has increased in the United States towards the end of the 19th century. Despite scientific agreement that vaccinations are safe and healthy, many people (including some scientists) believe that vaccinations (some or all) are unnecessary. People also believe vaccinations should not be mandatory and such laws violate civil rights and some religious rights. (<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1123944/>).

As a **final project** each group will present to the rest of the class (15–20 min presentation) a very compelling presentation about **either** the benefits of vaccination (you can pick any vaccination(s) you want to support) **or** the dangers of vaccinations (you can pick any example(s) you find). Both presentations should be supported by evidence (statistics, reports, YouTube videos, scientific articles, journal articles, and pseudoscience papers... anything you can logically use to defend your argument). Every presentation (10-15 slides) should use a critical thinking approach as prompted below:

- Gather, analyze and interpret relevant data presented in your resources to support your argument (vaccinations are important or not).
- Identify key problems (associated with using vaccines or not using vaccines).
- The possible alternatives.

The objective of this project is to establish a healthy discussion about a widely controversial topic as vaccination.

Grading Rubric

	Capstone	Milestone	Benchmark
Organization (specific introduction and conclusion, sequenced material within the body)	Excellent Clear and consistently observable, content is cohesive	Very good Clear and consistently observable	Is not observable in the presentation
Language	Compelling, imaginative, and memorable. Enhances the effectiveness of the presentation	Thoughtful and supports the effectiveness of the presentation	Unclear and minimally supports the effectiveness of the presentation
Supporting material (examples, explanations, statistics, analogies, illustrations, quotations)	Variety of types, make appropriate reference to information or analysis that supports the presentation	Two to three supporting material to establish the credibility of the presentation	Insufficient supporting material that minimally supports the presentation
Delivery (posture, eye contact, gesture, vocal expressiveness)	Compelling presentation and speakers appear polished and confident	Interesting presentation speakers appear confident	Detract from the understanding of the topic, speakers appear uncomfortable
Total	35	25	15

Sample of The Presentations

ANTI

[HTTPS://WWW.YOUTUBE.COM/WATCH?V=U8LVMTYHNL4&FEATU=RE=YOUTU.BE](https://www.youtube.com/watch?v=U8LVMTYHNL4&FEATU=RE=YOUTU.BE)

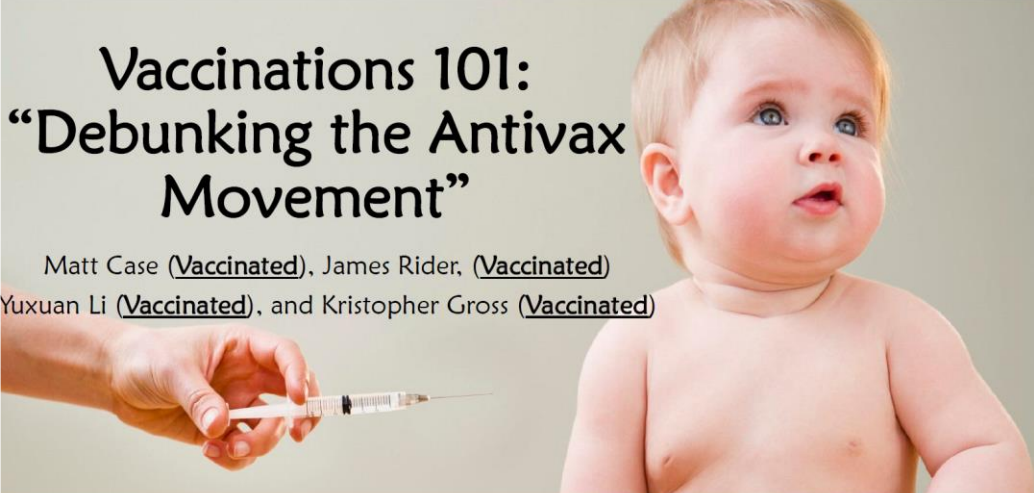


Say No to Vaccines

James Scheuer, Javier Martinez, Shelby Hill, Mia Bowman

PRO

[HTTPS://WWW.YOUTUBE.COM/WATCH?V=NNCPTXLCPRE](https://www.youtube.com/watch?v=NNCPTXLCPRE)



**Vaccinations 101:
“Debunking the Antivax
Movement”**

Matt Case (**Vaccinated**), James Rider, (**Vaccinated**)
Yuxuan Li (**Vaccinated**), and Kristopher Gross (**Vaccinated**)

Please assess the presentation of your fellow colleagues (1 excellent, 2 very good, 3 good, 4 poor, 5 very poor).
 Q1. How was the organization of the presentation?
 Q2. Did the group gather enough evidence?
 Q3. Was the argument compelling?
 Q4. Did the group critically think about the topic?
 Q5. How was the presentation delivery?

Peer Evaluations

Please assess the presentation of your fellow colleagues (1 excellent, 2 very good, 3 good, 4 poor, 5 very poor).

- Q1. How was the organization of the presentation?
- Q2. Did the group gather enough evidence?
- Q3. Was the argument compelling?
- Q4. Did the group critically think about the topic?
- Q5. How was the presentation delivery?

Last Name	First Name	Group Name	Q1	Q2	Q3	Q4	Q5	Comments
		The Atoms Family						
		The Free Radicals						
		We're Sodium Fine						
		James and the Gang						
		The Backside Attack						
		Netflix and Distill						

Conclusions...

- ✓ Students presentations were outstanding!
- ✓ Few comments from students for the anti-vaccination presentations:
 - *Almost convinced*
 - *10/10 solid arguments*
 - *Great engagement*
 - *Very well researched*
 - *Awesome!!*

Activity # 3: Tests

In addition to all other activities students took the following assessment tests:

- 2008 ACS “Diagnostic of Undergraduate Chemistry Knowledge” Exam
- The pre and post critical thinking assessment test
- The “ETS” Proficiency Profile test

Future Goals

WHAT WORKED

Students were very engaged in the class activities

The course is not “taxing”

Student input was excellent

Students learned to certain extent about how to critically think and analyze other points of view

WHAT’S NEXT

More class discussions involved in critical thinking

Another presentation related to controversial topics

THANK YOU

Suggestions?

Comments?

Questions?

Feedback?